(5) Waterloo
October 20, 1979

University of Waterloo

Waterloo, Ontario, Canada
N2L 3G1

Faculty of Science
Department of Biology
519/885-1211

17 August 1979

PLANT DEVELOPMENT WORKSHOP

FALL 1979

You and your colleagues are invited to attend the 5th Plant Development Workshop which will be held in the Biology Building at the University of Waterloo on Saturday, October 20, 1979. A map of the area and campus is enclosed. A quarter will buy you convenient parking in lot B.

Preliminary schedule:

9:00 - 9:30 A.M.	Coffee and registration
9:30 - 12:00 noon	Contributed papers (15 minutes each)
12:00 - 2:00 P.M.	Buffet lunch and discussion of contributed posters
2:00 - 4:30 P.M.	Contributed papers and/or discussion

Please send in your abstracts for papers and posters (maximum 250 words) by October 1 at the latest. Ideas for discussion would be welcomed and should be communicated soon.

Please address all correspondance to:

Dr. C.A. Peterson,
Department of biology,
University of Waterloo,
Waterloo, Ontario,
N2L 3G1.

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(3)

University of Waterloo

Waterloo, Ontario, Canada
N2L 3G1

Faculty of Science
Department of Biology
519/885-1211

12 October 1979

Dear Colleague,

Please find enclosed a schedule for the 5th Plant Development Workshop, Saturday October 20, University of Waterloo. The presentations will occur in the Biology Building 2nd floor, room 295 (near the elevators). If you have not already done so, please let me know the number of people we can expect from your laboratory. You may wish to keep in mind the suggestion of bringing along a promising undergraduate student. A buffet lunch will be provided at cost. For those wishing to dine out in Waterloo after the meeting, I would recommend "The Great West Beef Co." and will give you directions at the workshop.

See you soon.

Yours sincerely,

Carol A. Peterson

C.A. Peterson,
Assistant Professor.

Encl.
ff

(5)

SCHEDULE FOR THE 5th PLANT DEVELOPMENT WORKSHOP

UNIVERSITY OF WATERLOO

OCTOBER 20, 1979

9:00 - 9:30	Coffee and registration

CONTRIBUTED PAPERS

9:30 - 9:45	Endophyte-host cell interaction in Psilotum gametophytes. R.L. Peterson, University of Guelph
9:45 - 10:00	Development and fine structure of Dryas nodules. W. Newcomb, Queen's University
10:00 - 10:15	Root structure in Selaginella kraussiana. D. Grenville and R.L. Peterson, University of Guelph
10:15 - 10:30	Observations on the formation and ultrastructure of siliceous deposits occurring in the tissues of grasses and cereals. A.G. Sangster, York University
10:30 - 11:00	coffee break
11:00 - 11:15	DNA synthesis: differential inhibition by two methylxanthines. D. Davidson and S.W. Armstrong, McMaster University
11:15 - 11:30	Influence of cycloheximide on chromosome elimination in Hordeum. W.G. Wheatley and K.J. Kasha, University of Guelph
11:30 - 11:45	Cycloheximide induced changes in mitotic index, protein synthesis rates, and chromosome and nuclear organization in maize (Zea mays L.). C.L. Baszczynski, D.B. Walden and B.G. Atkinson, University of Western Ontario
11:45 - 12:00	Ultrastructure of Ubisch Body and Cuticle of Caltha palustris L. P-c. Cheng and M-i. Lin, University of Western Ontario
12:00 - 12:15	Agrichemical selection using maize pollen. K.A. Startek and D.B. Walden, University of Western Ontario
12:15 - 2:15	lunch and posters

POSTERS

Comparison of anther development in cytoplasmic male-sterile and male-fertile rice (*Oryza sativa* L.) P-c. Cheng, University of Western Ontario; Y-k. Cheng, National Taiwan University; and C-s. Huang, Taiwan Agricultural Research Institute.

Developmental morphology of the pistillate spikelets of corn (*Zea mays* L.): some preliminary observations. P-c. Cheng, R.I. Greyson and D.B. Walden, University of Western Ontario.

Towards androgenesis in corn. K. Raman, D.B. Walden and R.I. Greyson, University of Western Ontario.

Further observations on heterophylly in corn. W.J. Smith, R.I. Greyson and D.B. Walden, University of Western Ontario.

CONTRIBUTED PAPERS

2:15 - 2:30	Development of the dimorphic leaves of *Selaginella martensii*. N.G. Dengler, University of Toronto
2:30 - 2:45	Aspects of development in *Vallisneria americana* (Hydrocharitaceae) male inflorescences, male flowers and rhizome. U. Posluszny and M. Scott, University of Guelph; and V. Zelazny, McGill University
2:45 - 3:00	Senescence - related changes in the properties of membranes. J.E. Thompson, K.P. Pauls, R.F. Barber and L.S. Chia, University of Waterloo
3:00 - 3:15	The overwintering process in sugar maple: changes in carbohydrate reserves. E.B. Dumbroff, University of Waterloo
3:15 - 3:30	Developmental morphology of the floral galls of *Urophora affinis* and *Urophora quadrifasciata* (Order Diptera: Family Tephritidae) on diffuse knapweed. J.D. Shorthouse, Laurentian University
3:30 - 3:45	Developmental morphology of the balsam fir needle gall induced by the midge *Paradiplosis tumifex* (Gagné) (Order Diptera: Family Cecidomyiidae). R.J. West, Laurentian University
3:45 - 4:00	coffee

DISCUSSION PAPER

4:00	Insect galls and plant morphogenesis. J.D. Shorthouse, Laurentian University

PROGRAM FOR THE 5th PLANT DEVELOPMENT WORKSHOP
UNIVERSITY OF WATERLOO

OCTOBER 20, 1979

9:00 - 9:30 Coffee and registration

CONTRIBUTED PAPERS

9:30 - 9:45 Endophyte-host cell interaction in Psilotum gametophytes. R. L. PETERSON, *Department of Botany and Genetics, University of Guelph, Guelph.* Gametophytes of Psilotum nudum were found in greenhouse pots containing plants of Philodendron, Aspidistra or Hoya. Numerous antheridia, archegonia and rhizoids covered the surface of each gametophyte. An endophytic fungus is associated with most of the parenchyma cells, except functional sex organs and the meristems. The majority of rhizoids examined contained fungal hyphae. Infected parenchyma cells contained coils of fungal hyphae in various stages of degeneration and few cytoplasmic organelles. Mitochondria, plastids, endoplasmic reticulum, membrane-bound vesicles, and infrequent dictyosomes were present. Non-infected cells had more cytoplasmic organelles. Fungal hyphae penetrate cell walls in passing from cell to cell but little disruption of the wall occurs. As hyphae degenerate, lipid bodies accumulate in the hyphae and eventually, with complete hyphal degradation massive lipid bodies occur in the host cell cytoplasm. Membranous fragments are also found in the host cytoplasm at this time. Although the endophyte has been previously identified as a species of Cladochytrium attempts are being made to have the taxonomy clarified.

With thanks to Allan Anderson, Janet Vermeer, Melanie Howarth, and Dr. Dean Whittier for various aspects of the study.

9:45 - 10:00 Development and Fine Structure of Dryas Nodules. WILLIAM NEWCOMB, *Biology Department, Queen's University at Kingston.* Dryas plants are widely distributed in the Arctic in both the new and old world but only a few reports document the presence of nodules. Nodules of Dryas drummondi Richardson were collected at a rocky site on the banks of the Grand Rivierie in the Gaspe peninsula and prepared for correlated optical and electron microscopy. The endophyte of these nodules is an actinomycete which is encapsulated by a layer of Periodic acid-Schiff positive material. This bacterium forms non-septate oval-shaped vesicles at the ends of septate hyphae. These vesicles, the presumptive site of dinitrogen reduction, are distributed throughout the cytoplasm of infected cells. Thus, this microbe differs morphologically from the actinomycetous endophytes present in other non-leguminous root nodules. Possible reasons (i.e. speculations) on why only a few botanists have collected Dryas nodules will be presented.

10:00 - 10:15 Root Structure in Selaginella kraussiana. D. GRENVILLE and R. L. PETERSON, *Department of Botany and Genetics, University of Guelph, Guelph.* Roots (rhizophores) of Selaginella have intrigued Botanists for years because of their exogenous origin from angle meristems on the stem. These meristems have the capacity to initiate shoots under certain experimental conditions. Although a number of species have been examined in an attempt to clarify the morphological nature of the rhizophore, few studies have included ultrastructural observations. Although roots of S. kraussiana have been studied there is no information on the ultrastructure of this organ. Roots of this species were examined at various stages of development from their initiation from the stem through to soil penetration, and changes in the root apex documented. The aerial root is covered by a cap of thick-walled cells possessing a thick cuticle on the outer tangential cell wall. The cytoplasm of these cells is very dense and appears inactive. Dichotomy of the root apex often occurs before the root reaches the soil. As the root penetrates the soil, the thick-walled cells are lost and the apical meristem is covered by a structure more typical of a root cap. Since the factors controlling root dichotomy and root hair initiation are unknown in this genus, studies are being planned in this direction.

10:15 - 10:30 Observations on the formation and ultrastructure of siliceous deposits occurring in the tissues of grasses and cereals. A. G. SANGSTER, *Division of Natural Science, York University, Toronto.* Scanning and transmission electron microscope investigations of tissues of selected genera of grasses (family Poaceae) are utilized to illustrate the major categories of solid silicon deposits occurring in (1) cell lumina, (2) cell walls and (3) extracellular loci. The ultrastructural features obtained from studies of root deposits in the endodermis of several economically important grasses, as well as more recent studies of deposits in the cortical intercellular spaces, are described. The possibility of preferential deposition sites for silicon in the cell wall lamellae is raised.

The ultrastructural evidence upon which a classification of deposits might be based, or evolutionary trends deduced, is assessed.

10:30 - 11:00 Coffee break

11:00 - 11:15 DNA synthesis: differential inhibition by two methylxanthines. D. DAVIDSON and S. W. ARMSTRONG. *Biology Dept., McMaster University, Hamilton.* Lateral roots of Vicia faba were treated for one hour with a 0.1% solution either of caffeine or of isobutyl-methylxanthine (IBMX). Both compounds induce the formation of binucleate cells. The progress of this marked subpopulation of cells through a growth cycle was monitored by determining: 1) passage through the S phase, and 2) entry into

mitosis. Though the binucleate cells were almost identical one hour after the end of treatment, at least in terms of their nuclear volumes, their subsequent behaviour in interphase differed, depending on whether they were induced with caffeine or IBMX. Of the caffeine induced binucleate cells only ∿ 15% had entered mitosis 12 to 14 hours after they were first formed; micro-spectrophotometry showed that only 15% had undergone S by 14 hours. These observations contrast sharply with those from IBMX treated roots, i.e. about 90% of the binucleate cells had undergone S by 12 hours and ∿ 70% of them had divided by 18 hours. IBMX and caffeine evoke different responses from cells induced to become binucleate: the differential aspect of the response of proliferating cells to different methylxanthines suggests a potential approach to the control of cell proliferation. It also raises questions about the mechanism of formation of binucleate cells under normal conditions, e.g. in tapetum.

11:15 - 11:30 Influence of cycloheximide on chromosome elimination in Hordeum. W. G. WHEATLEY and K. J. KASHA, *Crop Science Department, University of Guelph, Guelph.* The control of chromosome elimination resulting in the production of haploids from interspecific hybrids of Hordeum is of interest from the point of both understanding the mechanism and its application to other species. An increase in the frequency of mitotic cells undergoing chromosome elimination in interspecific hybrids of Hordeum can be induced by 0.5 to 1.0 h treatments with cycloheximide, a potent protein synthesis inhibitor (K. Noda, unpublished). The cell cycle events of this induced chromosome elimination can be further analyzed using partially synchronized dividing cell population from root meristems of the diploid interspecific hybrid (H. vulgare-H. bulbosum) $R_2$5788. At the end of a 1 h treatment with 10 µg/ml cycloheximide, increases in the frequency of non-congressed chromosomes at metaphase are observed. At 1 and 2 hours after treatment with cycloheximide marked increases in lagging chromosomes at anaphase and telophase are noted. In addition, both the frequency of mitotic cells exhibiting chromosome elimination and the number of chromosomes per affected cell showing these traits are increased. Later, the frequency of interphase cells with micronuclei and both the number and size of micronuclei per cell also increase. Prophase cells which are not capable of progressing through to metaphase accumulate while the percentage of cells in metaphase, anaphase and telophase decline during recovery. Indications are that cells capable of entering metaphase after cycloheximide treatment continue through mitosis although at a slower rate and with varying degrees of altered spindle structure. It is concluded that disruption of protein synthesis during prophase alters cell cycle events in these interspecific hybrid cells which are necessary for the proper congression of chromosomes at metaphase and this results in the eventual elimination of these non-congressed chromosomes during mitosis.

11:30 - 11:45 Cycloheximide Induced Changes in Mitotic Index, Protein Synthesis Rates, and Chromosome and Nuclear Organization in Maize (Zea mays L.). C. L. BASZCZYNSKI, D. B. WALDEN, and B. G. ATKINSON, *Department of Plant Sciences, University of Western Ontario, London.* Cycloheximide was used to study various aspects of cellular metabolism in maize root tip cells. Changes in the mitotic index were monitored over an eight hour period following treatment of intact root tips with cycloheximide for various times and concentrations. Although mitotic index curves were different for each treatment, certain features such as a decrease in prophase frequency at a specific time remained fairly constant, thus providing information as to possible sites of blocks in the nuclear cycle. Total protein synthesis rates as well as the synthetic rates of the nuclear protein fraction were measured at various doses of cycloheximide. Nuclear protein synthesis was found to be inhibited to a greater extent at a lower dose than total protein synthesis. The rate of recovery of this activity was also found to be dose-dependent. At somewhat higher concentrations of cycloheximide, an elevation in the frequency of variations associated with chromosome structure and organization in the nucleus were noted. Nine classes of these variants were observed at frequencies significantly higher than the controls. These results indicate an inter-relationship of several metabolic processes.

11:45 - 12:00 Ultrastructure of Ubisch Body and Cuticle of Caltha palustris L. PING-CHIN CHENG and MAI-ING LIN, *Department of Plant Sciences, University of Western Ontario, London.* The fine structure and Ubisch bodies of Caltha palustris L. was studied by TEM and SEM. The material was fixed in Cheng's fixative, postfixed in OsO_4, dehydrated in acetone and embedded in Spurr's medium. An electron-dense core structure associated with fine vesicular-like structures was observed in the Ubisch body. The electron dense core has a 40A° "white line" structure, its function is not known. As with pollen excine Ubisch bodies can be dissolved in 2-aminoethanol at 70 C. We present a hypothesis to explain the mechanism of Ubisch body formation.

When viewed by TEM of thin sections, the anther and filament cuticle of Caltha palustris appear to be an electron transparent layer penetrated by a reticulum network which emanates from the cell wall. The cuticle is similar to those previously described by others. The surface of the anther cuticle is very smooth but that of the anther filament surface possesses low ridges.

12:00 - 12:15 Agrichemical Selection Using Maize Pollen. K. A. STARTEK and D. B. WALDEN, *Department of Plant Sciences, University of Western Ontario, London.* A bioassay system utilizing the in vitro germination of maize pollen has been developed to determine levels of resistance/tolerance to agrichemicals. Preliminary data from three inbred lines tested against three concentrations of three agrichemicals indicate that the growth of pollen tubes in the

presence of these chemical stresses varies with respect to the genotype of pollen used. These results suggest a differential response to agrichemicals exists in corn pollen and that the response is genotypically determined. In total, data for twenty genetic stocks of corn and ten agricultural chemicals have been collected. The analysis of these data is now in progress.

12:15 - 2:00 Lunch and posters

POSTERS

Comparison of Anther Development in Cytoplasmic Male-Sterile and Male-Fertile Rice (Oryza sativa L.). PING-CHIN CHENG, *Department of Plant Sciences, University of Western Ontario, London.* YU-KUEI CHENG, *Department of Agronomy, National Taiwan University, Taipei, Taiwan, Rep. of China 107* and CHEN-SENG HUANG, *Taiwan Agricultural Research Institute, Taichung Hsien, Taiwan, Rep. of China 431.* Anther development of cytoplasmic male-sterile (cms) rice (Oryza sativa L.) was compared with its fertile material. The rice plants were grown in pots in the greenhouse of Department of Agronomy, National Taiwan University, Taipei. Anthers were fixed in Cheng's fixative, postfixed in OsO_4, dehydrated in acetone and embedded in Spurr's medium. From the preliminary studies, the early degeneration of tapetum cells and microspores at young microspore stage are the first sign of anther abortion. The exine of the cms microspore is formed in a normal fashion and Ubisch body could be found both in cms and fertile anthers.

Extensive epidermal ridges were found in fertile anthers but not in cms anthers. No ridges were found both in IMS1 and IMS2 (inter-microsporangial stripe 1 and 2) of the fertile material.

In addition we conclude that there are fewer plastids in tapetal cells than in fertile anthers.

Developmental Morphology of the Pistillate Spikelets of Corn (Zea mays L.): Some Preliminary Observations. PING-CHIN CHENG, R. I. GREYSON and D. B. WALDEN, *Department of Plant Sciences, University of Western Ontario, London.* Organ initiation of corn flower of both the male and female inflorescence is a precisely controlled mechanism - two flowers are produced in each spikelet. In the tassel both flowers are functional, each containing three anthers and an aborted pistil. In the ear, only the upper flower develops, while the lower flower and the anthers of the upper flower abort. This study presents a developmental scheme for the timing and anatomical changes.

Developmental sequences of pistillate flower were followed by SEM and are illustrated. Stereo pairs of SEM photos were prepared to help with the understanding of 3-dimensional arrangement of different organs. The three anthers in a flower are not initiated

together. Two are initiated first at 180° to each other and the third is initiated at lower level at 90° to the previous two.

Towards Androgenesis in Corn. K. RAMAN, D. B. WALDEN and R. I. GREYSON, *Department of Plant Sciences, University of Western Ontario, London.* The pollen in immature anthers of certain angiosperms, when cultured at an appropriate stage of development on a suitable nutrient medium may form sporophytic plants with the haploid set of chromosomes. Continued cell divisions in a small proportion of pollen grains inside the excised and cultured anthers can lead to the formation of 'embryoids' or unorganized callus growth. The embryoids develop directly into plantlets whereas callus, on transfer to an inducing medium, can be induced to differentiate shoots and roots. This phenomenon (known as androgenesis) has been reported to occur readily in Solanaceous species and only occasionally in some other important crop species such as cereals.

Except for a recent report, induction of androgenesis in corn has met with very little success (Han, H. et al. 1978). Our display presents examples of the early ontogenetic events in the development of a uninucleate corn pollen grain to a 'callus'. Anthers bearing uninucleate pollen grains, when cultured on a defined medium, underwent division in 5 days. The sustained division within the pollen resulted in the formation of multicellular masses within 20 days. Approximately 50% of the anthers cultured produced these multicellular unorganized structures. All attempts to induce differentiation, or to maintain the cell division in order to produce a large callus, are unsuccessful so far.

Further Observations on Heterophylly in Corn. W. J. SMITH, R. I. GREYSON and D. B. WALDEN, *Department of Plant Sciences, University of Western Ontario, London.* We have previously described the heterophyllic feature of corn. Some additions to this story are now possible.

a) Double-log plots of internode length and widths illustrate that in addition to changes in leaf shape along the stem, internodes demonstrate heteroblasty.

b) Double-log plots of leaf length and widths from large samples (N = 10) reveal consistent cultivar-related curves, i.e. this method of documentation summarized plant shape for individual cultivars.

Simple Techniques for the Study of the Root Structure of Field Grown Corn. T. STRANGE and J. VERMEER, *Department of Biology, Carleton University, Ottawa.* Increasing interest in the soil root interface and its biological implications has resulted in the need for simple techniques allowing for both the study of roots in situ and a more detailed anatomical study of roots grown under natural conditions. To date much of the information on the structure and histochemistry of corn roots comes from studies of the primary

roots of seedlings grown under sterile conditions. In order to study the natural root system of corn, several simple techniques including the gelatin impregnation of cores of root/soil samples, observation of roots in glass-sided growth boxes and excavation of intact root samples on a nail board, have been used. Roots and root/soil cores can be hand sectioned and observed by bright field or fluorescence microscopy.

CONTRIBUTED PAPERS

2:00 - 2:15 A Study of Mucilage Secretions by Developing Root Epidermal Cells of Zea mays L. by Using Correlated Optical and Electron Microscopy. K. J. CLARKE and M. E. McCULLY, *Department of Biology, Carleton University, Ottawa.* The epidermal cells of young roots secrete components to the surrounding rhizosphere. The root epidermis of Zea mays L. is a uniseriate layer which is continuous with the distal layer of the quiescent centre and during development the epidermal cells undergo marked shape change. The epidermal cells at the distal layer of the quiescent centre are periclinally flattened, on the meristem flank these cells become columnar and subsequently tabular in the region of root hair initiation. The extracellular surface deposit of the epidermal cells is a closely adhering firm hydrophobic mucilage overlaying these cells even at the distal layer of the quiescent centre, it thickens to maximal secretion over the meristematic columnar epidermis at the flanks of the root tip and then thins markedly as the epidermal cells become tabular and root hair initiation begins.

The developmental sequence of the epidermis and its associated extracellular surface deposit was studied using a variety of histochemical reactions together with polarising and fluorescence microscopy and fine structural studies. The epidermal surface deposit has been shown to differ significantly from the well characterised mucilage secreted by the root cap cells and the retention and specific staining properties of both these materials has been shown to be noticeably influenced by the fixation schedules used.

The results of this study suggest that care should be taken in interpreting both the origin and the structural and histochemical properties of the root-derived mucilages in the rhizosphere.

2:15 - 2:30 Development of the Dimorphic Leaves of Selaginella Martensii. NANCY G. DENGLER, *Department of Botany, University of Toronto, Toronto.* The mature leaves of Selaginella martensii show a strong dimorphism in size and morphology. A large dorsal leaf and a small ventral leaf are initiated as a pair at the shoot apex. Measurements based on serial cross sections of plastic-embedded shoot apices and on cleared and stained young leaves which had been sequentially dissected from the shoot apex show that the rate

and duration of growth in area differ for the two leaf types. Growth in length of the small dorsal leaves ceases at the P7 position and at the P12 position for large ventral leaves. Growth of the ligule proceeds allometrically and ceases where both leaf types are 800 µm in length, about P4 for both. Measurements of cell size show that cells of the leaf apex reach mature size early when the leaf is about 500 µm in length, P3 for both leaf types. Meristematic activity is confined to the basal portion of the leaf and cell division ceases at about P8 (1600 µm) for large ventral leaves and about P4 (1000 µm) for small dorsal leaves. Observations using scanning electron microscopy and longitudinal sections of the apex indicate that the pattern of initiation is similar for both types although the zone of initiation for the ventral leaves has a greater lateral extent resulting in a larger primordium of the leaf buttress stage. These observations document the divergent developmental pathways resulting in anisophylly in this species.

2:30 - 2:45 Aspects of Development in Vallisneria americana (Hydrocharitaceae); Male Inflorescences, Male Flowers and Rhizome. U. POSLUSZNY, and M. SCOTT, *Department of Botany and Genetics, University of Guelph, Guelph* and V. ZELAZNY, *Biology Dept. McGill University, Montreal.* The family Hydrocharitaceae occupies an important position in the phylogeny of the Monocotyledons. Vallisneria americana, a very common aquatic in the lakes and streams of Ontario and Quebec was collected in early summer in order to study the developing male inflorescences and flowers. This species is dioecious with the female plant producing solitary flowers. The male inflorescences arise in a cyme-like pattern in the axil of a leaf. Each inflorescence is sheathed by two bracts. The male flowers are initiated almost simultaneously on the inflorescence, forming hundreds of minute floral buds...many no more than 6 cells across. The development of the male flower is acropetal. First to form are 3 sepals followed by a reduced petal and staminode and finally the two fertile stamens. The flower at maturity has a very thin brittle peduncle which breaks allowing the stamens to reach the surface of the water where pollination occurs. The last structure to form at the base of the male inflorescences is the rhizome apex. It forms an unusual "tower-like" structure on which further aerial shoots are initiated precociously, very close to the rhizome apex.

2:45 - 3:00 Senescence-related Changes in the Properties of Membranes. J. E. THOMPSON, K. P. PAULS, R. F. BARBER and L. S. CHIA, *Department of Biology, University of Waterloo, Waterloo.* Wide angle X-ray diffraction of chloroplast and microsomal membranes from senescing bean leaves has revealed that portions of the lipid bilayer become crystalline as the tissue senesces. For young leaves the transition temperature is about 23°C for microsomes and below -30°C for chloroplast membranes, indicating that at physiological temperature the lipid is entirely liquid-crystalline. By 5 weeks the transition temperature has risen to 43°C for microsomes and 52°C for chloroplasts, and there has been

substantial loss of chlorophyll and protein.

These changes in membrane phase properties can be simulated by treating the plants with 10 PPM paraquat. Within 48 h of treatment, the transition temperature rises from 23°C to 57°C for microsomes and from below -30°C to 24°C for chloroplasts. At higher concentrations of paraquat the changes are induced within 12 h of treatment. Paraquat is known to form cation radicals which react with oxygen to produce O_2^-, and has been implicated as an agent of lipid peroxidation.[2] Accordingly, these observations suggest that the formation of crystalline lipid in membranes during natural senescence could be due to free radical damage.

3:00 - 3:15 The Overwintering Process in Sugar Maple: Changes in Carbohydrate Reserves. E. B. DUMBROFF, *Department of Biology, University of Waterloo, Waterloo.* Relationships between changes in reserve carbohydrates and other physiological phenomena associated with the winter and spring seasons were examined in sugar maple seedlings exposed to the natural environment. A control group was potted and placed in a greenhouse in early fall and exposed to warm temperatures and a 16-hour photoperiod. Samples of root and stem tissue from both groups were examined for starch and sugar content at approximately monthly intervals. Starch formed the major portion of all reserve carbohydrate throughout the year except during the period of most active shoot growth in late spring. From leaf abscission in late October through late April, total reserves constituted 36 to 42% of tissue dry weight in roots and 12 to 17% in stems. In late February or early March, the reserves began a moderate decline that coincided with a sharp increase in moisture content of the buds. Following budbreak in May, carbohydrate reserves fell rapidly, reaching their lowest levels in June after completion of the most active period of shoot growth. Concentrations of soluble sugars in roots and stems reached maxima of 9 to 11% in January and minima of 2 to 4% in September. The changes observed in the carbohydrates were closely associated with major physiological events, and their trends are not inconsistent with regulatory roles in dormancy phenomena.

3:15 - 3:30 Coffee break

3:30 - 3:45 Developmental Morphology of the Floral Galls of Urophora affinis and Urophora quadrifasciata (Order Diptera: Family Tephritidae) on Diffuse Knapweed. J. D. SHORTHOUSE, *Department of Biology, Laurentian University, Sudbury.* Diffuse knapweed (Centaura diffusa) is a noxious weed of European origin which infests about 30,000 ha. of prime rangeland in British Columbia. The weed is difficult to control by herbicides and so the two tephritid flies U. affinis and U. quadrifasciata were introduced into Canada as part of a program in biological control.

U. affinis attacks the immature flower heads and forms a thick walled gall on the receptacle. U. quadrifasciata attacks flower heads at a later stage of maturity and forms a thin walled gall from tissues of the ovary. The presence of either gall in diffuse knapweed flower heads causes the abortion of developing seeds.

3:45 - 4:00 Developmental Morphology of the Balsam Fir Needle Gall Induced by the Midge Paradiplosis tumifex (Gagné) (Order Diptera: Family Cecidomyiidae). R. J. WEST, *Department of Biology, Laurentian University, Sudbury.* Morphological changes during initiation, growth, and maturation of the balsam fir needle gall are discussed. The gall is composed of hypertrophied mesophyll cells and lacks the differentiated layers of cells characteristic of other cecidomyiid galls.

An inquiline cecidomyiid, Dasineura balsamicola, is a common inhabitant of the gall, but has little influence on normal gall morphogenesis.

DISCUSSION PAPER

4:00 Insect Galls and Plant Morphogenesis. J. D. SHORTHOUSE, *Department of Biology, Laurentian University, Sudbury.* Insect induced galls are initiated by tissue stimulating agents supplied by the larvae of specialized insects. The development of galls involves factors that release plant cells from their normal morphogenetic coordinating influences and the host plant is provoked into surrounding the feeding site of the insect with several layers of highly nutritious cells.

Understanding the mechanisms of gall growth allows us to examine the genetic potentials of plant tissues not normally expressed. They show us how easily tissues submit to reorganization if a new organizer can be introduced onto a mass of growing cells. Insect galls are organized entities which appear to have significant bearing on fundamental problems of tissue differentiation, organ determination, and the organic relationships between animal and plant cells.

Theories as to how gall formers have evolved control over morphogenesis will be discussed.